Abstract of Contribution 226

ID: 226
Oral
Topics: Data-Model Integration for a better understanding of Past Climatic and Environmental Dynamics
Keywords: Interglacials, Abrupt changes, Astronomical forcing, Paleoclimate modelling, Speleothems

Insolation triggered abrupt climate changes confirmed by speleothem records

Qiuzhen Yin, Zhipeng Wu
Georges Lemaître Centre for Earth and Climate Research, Earth and Life Institute, Université Catholique de Louvain, Louvain-la-Neuve, Belgium

Various paleoclimate records show that the end of interglacials of the late Pleistocene was marked by abrupt cooling events. Strong abrupt cooling occurring when climate was still in a warm interglacial condition is puzzling. Our transient climate simulations for all the eleven interglacial (sub)stages of the past 800,000 years show that there exists a threshold in the astronomically induced insolation below which abrupt changes at the end of interglacials occur (Yin et al., 2021). When the summer insolation in the Northern Hemisphere (NH) high latitudes decreases to a critical value, it triggers a strong, abrupt weakening of the Atlantic meridional overturning circulation and a strong cooling in the NH followed by high-amplitude variability. The mechanism involves sea ice feedbacks in the Northern Nordic Sea and the Labrador Sea. Similar abrupt oscillations happen in the simulated temperature, precipitation and vegetation from low to high latitudes. The simulated results are supported by observations from different marine and terrestrial records. In particular, the simulated abrupt events at the end of interglacials are confirmed by high-resolution speleothem records from China. Strong, abrupt shifts in oxygen and carbon isotope compositions are observed in the speleothem records, which is suggested to indicate abrupt weakening of the Asian monsoon and abrupt environmental changes. Similar abrupt changes are also observed in speleothem records from Europe. The timings of the abrupt events observed in the speleothem records are highly consistent with those simulated by the model, validating the model results and revealing that the astronomically-induced slow variation of insolation could trigger abrupt climate events.

The model results show that the insolation threshold occurred at the end of each interglacial of the past 800,000 years, suggesting its fundamental role in terminating the warm climate conditions of the interglacials. The next insolation threshold will occur in 50,000 years, suggesting an exceptionally long interglacial ahead, which is in line with what has been suggested by previous modelling studies.

Reference: Yin Q.Z., Wu Z.P., Berger A., Goosse H., Hodell D., 2021. Insolation triggered abrupt weakening of Atlantic circulation at the end of interglacials. Science, 373, 1035-1040, DOI: 10.1126/science.abg1737